

ORIGINAL ARTICLE

Correlation Between Gastroesophageal Reflux Disease Questionnaire and Erosive Esophagitis in School-aged Children Receiving Endoscopy



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Key Words

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Background: The gastroesophageal reflux disease (GERD) questionnaire (GerdQ) is a validated questionnaire that was developed recently to help identify GERD patients. The sensitivity and specificity of GerdQ for the diagnosis of GERD in adult patients were 65% and 71%, respectively. Because the application of GerdQ in pediatric population is largely unknown, the aim of this study is to establish the endoscopic correlation between Chinese GerdQ and grades of erosive esophagitis (EE) in Taiwanese children.

Methods: Seventy-four children (aged 9–18 years) were evaluated by our version of the Chinese GerdQ prior to receiving esophagogastroduodenoscopy for warning upper gastrointestinal symptoms. Grades of EE were assessed blindly, according to the Los Angeles classification. The sensitivity and specificity of GerdQ for detecting endoscopic EE were analyzed.

Results: In 74 patients, the male to female ratio was 1:1.1 and the mean age was 14.2 ± 2.3 years (age range: 9.2–17.9 years). Thirty-nine percent of the enrolled patients had EE. The sensitivity and specificity of GerdQ (with a cutoff score of ≥ 7) to identify EE patients were 65.5% and 80%, respectively. The odds ratio of GerdQ for a cutoff score of 7 to identify EE was 7.6 (95% confidence interval = 2.6–21.9, $p < 0.001$).

Conclusion: For the identification of EE in children, the Chinese GerdQ had similar sensitivity and specificity to that used for adults. This questionnaire may be applied as a noninvasive screening tool.

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1. Introduction

Gastroesophageal reflux is the involuntary passage of gastric contents into the esophagus and is a normal physiological process. Gastroesophageal reflux disease (GERD) occurs when the reflux of gastric contents causes annoying symptoms and/or complications.^{1,2} The manifestations of GERD range from the presence of symptoms such as heartburn or regurgitation without erosions on endoscopic examination (nonerosive disease) to more complicated diseases such as erosive esophagitis (EE), esophageal stricture, or Barrett esophagus. EE was defined as visible breaks of the esophageal mucosa detected by esophagogastroduodenoscopy (EGD).³ The prevalence of EE in children with GERD symptoms reported in different studies was 10–50%.^{4–8}

EGD is an invasive procedure in pediatrics, which is not suitable for large-scale screening of GERD. In adults, diagnosis of GERD is mainly based on the presence of GERD symptoms, namely, heartburn and regurgitation.⁹ The GERD questionnaire (GerdQ) was recently developed to help identify patients with GERD. The sensitivity and specificity of GerdQ for the diagnosis of GERD in adult patients were 65% and 71%, respectively.¹⁰ In addition, the detection of adult reflux esophagitis was found to be parallel to the increase in GerdQ scores.¹¹ Therefore, GerdQ can be used for the diagnosis of EE in adults.

Although GerdQ has been shown to be effective in identifying adult EE patients, its application in the pediatric population is largely unknown. In this study, we aimed to establish the roles of the Chinese version of GerdQ in Taiwanese school-aged children who received EGD for warning upper gastrointestinal symptoms.

2. Methods

2.1. Enrolled patients

From January 2011 to March 2012, a total of 74 children, aged 9–18 years, received EGD for warning upper gastrointestinal symptoms, including epigastralgia, dysphagia, heart burn sensation, regurgitation, upper gastrointestinal tract bleeding, intractable vomiting, anemia, and abnormal weight loss, at the Department of Pediatrics, National Taiwan University Hospital, Taipei, Taiwan. Indications and warning signs of EGD are shown in Table 1. Twenty-three (31.1%) patients were prone to EE: two (2.7%) with esophageal diseases, six (8.1%) hiatal hernias, one (1.4%) intractable vomiting, six (8.1%) upper gastrointestinal bleeding, and eight (10.8%) morbid obesity. Prior to EGD, the children completed the Chinese version of GerdQ themselves or with the assistance of their parents (the Chinese version of GerdQ can be found in the supplementary material online). The study nurse collected these data, which were blinded to the investigator. Children with neuromuscular disease or language problems were excluded from the study.

The study protocol was approved by the institutional review board and the ethics committee of the National Taiwan University Hospital. Patients were recruited in this study after obtaining written informed consent from their parents or legal guardians.

Table 1 Indication and warning signs for EGD.

Indications and warning signs	Patient number
Epigastralgia	42 (56.8)
Heart burn sensation, regurgitation	16 (21.6)
Upper gastrointestinal tract bleeding (hematemesis, tarry stool)	6 (8.1)
Dysphagia	4 (5.4)
Esophageal varices follow-up	3 (4.1)
Anemia	1 (1.3)
Abnormal weight loss	1 (1.3)
Intractable vomiting	1 (1.3)

Data are presented as *n* (%).

2.2. Chinese GerdQ for older children

In this study, we developed a Chinese version of GerdQ suitable for children aged 9–18 years (see the supplementary material online). It is based on the GerdQ used for adults, previously documented in terms of content validity and psychometric properties, and data on the diagnosis of GERD in primary and secondary care.¹⁰ Six GERD-related symptoms, including heartburn, reflux, epigastralgia, nausea, sleep disturbance, and taking over-the-counter drugs, were assessed by subjective reporting of the enrolled children. Each item was scored according to their frequency of occurrence in the past week (4-point scales: never, 1 day, 2–3 days, and 4–7 days). The Chinese version of GerdQ was obtained after the step of cross-cultural adaptation. The methodological procedure of cultural adaptation included the following steps: translation, synthesis, backtranslation, assessment by an expert committee, and pretest (unpublished data). The Chinese GerdQ used in this study was similar to that used for adults in Taiwan.

2.3. EGD examination and classification of esophageal mucosal injury

Flexible video endoscopy was performed to evaluate the esophagus, stomach, and duodenum in each patient after the Chinese version of GerdQ had been completed. The presence and degree of esophageal mucosal injury were graded according to the Los Angeles (LA) classification, which describes four grades of esophagitis severity (A–D) based on the extent of esophageal lesions known as mucosal breaks.^{12,13} Although the LA classification is generally used for adults, it is also suitable for children.³ The diagnosis of different grades of EE was made by a gastrointestinal specialist who was double-blinded to the corresponding GerdQ scores that were collected by the study nurse.

2.4. Statistical analysis

Data were expressed as mean \pm standard deviation unless otherwise noted. The two-sample *t* test was used to assess the statistical significance of age, body mass index (BMI), and GerdQ score, and Chi-square test for sex according to the presence or absence of EE. The correlation between GerdQ scores and EE was evaluated using the receiver operating

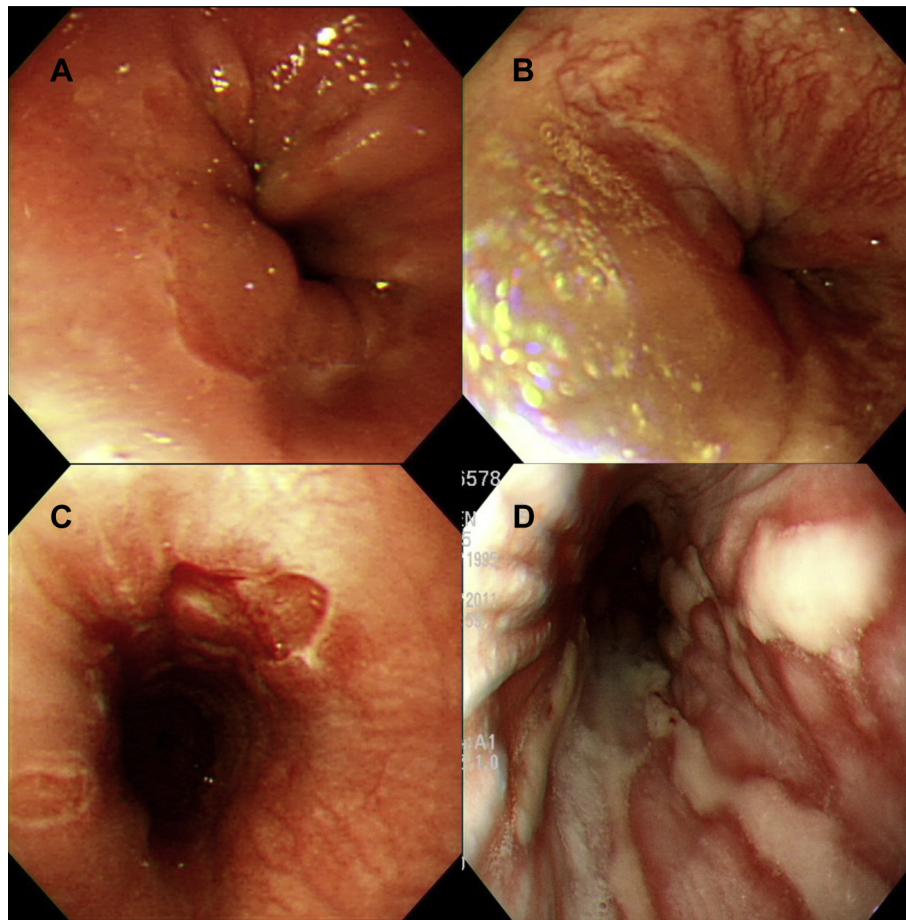


Figure 1 Endoscopic pictures of our cases for grades A–D of EE. (A) Grade A: one or more mucosal breaks confined to the mucosal folds, each not more than 5 mm in maximum length. (B) Grade B: one or more mucosal breaks more than 5 mm in maximum length, but not continuous between the tops of two mucosal folds. (C) Grade C: mucosal breaks that are continuous between the tops of two or more mucosal folds but involve less than 75% of the esophageal circumference. (D) Grade D: mucosal breaks that involve at least 75% of the esophageal circumference.

characteristic (ROC) analysis to find an optimal threshold score with the maximal sum of sensitivity and specificity for the identification of EE patients.¹⁴ The significance of classifying patients into EE and non-EE groups according to the GerdQ scores was assessed using the Chi-square test and the odds ratio (OR) with 95% confidence interval (CI). A *p* value of <0.05 was considered statistically significant. Statistical calculations were performed with the STATA package software (StataCorp LP, College Station, TX, USA).

3. Results

3.1. Clinical characteristics and endoscopic findings

In 74 patients, the male to female ratio was 1:1.1 and the mean age was 14.2 ± 2.3 years (9.2–17.9 years). The mean BMI was 20.3 ± 4.4 kg/m². They presented with warning upper gastrointestinal symptoms in the clinics. EE was endoscopically documented in 29 patients (39.2%), among which 22 (75.8%) were diagnosed to have mild EE (LA grade A or B). Representative endoscopic pictures of EE patients (LA grades A–D) are shown in Figure 1.

3.2. EE versus non-EE

Patients' endoscopic findings and GerdQ scores are shown in Table 2. The mean GerdQ score was higher for patients with EE than for patients without the disorder (6.9 ± 2.5 vs. 5.8 ± 2.1 , $p = 0.03$). Although GerdQ scores were shown to be statistically different between patients with and without EE, the difference in GerdQ scores among patients with low-grade EE (A and B; median score 7; range 3–11) and high-grade EE (C and D; median score 7; range 4–11) was not statistically significant (Mann–Whitney *U* test, $p = 0.88$). Distribution of the GerdQ total scores of patients with EE (for each LA grade) is shown in Figure S1 in the supplementary material online. There is no trend of GerdQ scores among the four LA grades ($p = 0.78$). In addition, no statistically significant differences were observed in age (14.4 ± 2.4 years vs. 13.7 ± 2.2 years, $p = 0.20$), BMI/ (average BMI of same-age patients) (1.0 ± 0.2 vs. 1.1 ± 0.3 , $p = 0.34$), and sex (Chi-square test, $p = 0.81$) between EE and non-EE groups.

We employed ROC analysis to determine a cutoff score for the identification of EE patients, indicating a GerdQ score of 7 as the threshold (Figure 2). In other words,

Table 2 EGD finding and GerdQ scores of the study population.

Total patients = 74	GerdQ scores			
	0–2	3–6	7–10	11–18
Non-EE (n = 45, 60.8%)	3 (4.1)	32 (43.2)	8 (10.8)	2 (2.7)
EE (n = 29, 39.2%)	0 (0)	10 (13.5)	17 (23.0)	2 (2.7)
Grade A (n = 15, 51.7%)	0 (0)	5 (6.8)	10 (13.5)	0 (0)
Grade B (n = 7, 24.1%)	0 (0)	3 (4.1)	3 (4.1)	1 (1.4)
Grade C (n = 5, 17.2%)	0 (0)	1 (1.4)	3 (4.1)	1 (1.4)
Grade D (n = 2, 6.9%)	0 (0)	1 (1.4)	1 (1.4)	0 (0)

Data are presented as n (%).

patients with a GerdQ score of ≥ 7 were identified to have EE. The true positive diagnostic rate was 67.9% and the true negative diagnostic rate 78.3%, whereas the sensitivity and specificity were 65.5% and 80.0%, respectively. The results are similar to those of an adult study, in which the sensitivity and specificity of GerdQ for GERD identification were 65% and 71%, respectively.¹⁰ The discriminatory power of GerdQ to distinguish between patients with and without EE was further assessed, and the OR was 7.6 (95% CI = 2.64–21.90, $p < 0.001$). Subsequently, we explored if the prediction accuracy was age dependent. We found that the prediction accuracy was similar for patients aged 9–15 years. For senior high school patients (15–18 years old), higher sensitivity (72.7%) but lower specificity (71.4%) resulted in a lower true positive diagnostic rate (57.1%) for EE (Table S1 in the supplementary material online).

4. Discussion

Only a few noninvasive tools are available for screening GERD in children.^{15–18} Although GerdQ has been developed

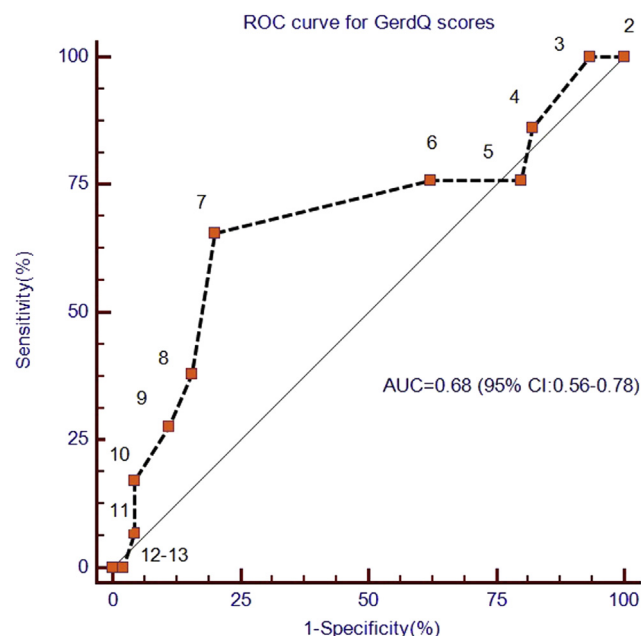
successfully to help identify adult patients with GERD, a questionnaire, validated by comparing it with objective standards such as endoscopy, 24-hour esophageal pH monitoring, or esophageal multichannel intraluminal impedance monitoring, is still scarce in children.^{19–22} The presenting symptoms of GERD in children are age related, and their reported symptoms are unreliable for those under the age of 8 years.^{1,23,24} Therefore, we recruited those aged 9–18 years in this study. Results of this study indicate a good discriminatory power of GerdQ to distinguish between patients with and without EE. Because EGD is not suitable as a large-scale screening tool for children, GerdQ may serve as a noninvasive diagnostic tool. We expected that GerdQ could be helpful in EE epidemiological studies.

The GerdQ was developed as an exploratory part of the Diamond study initially. Primary-care patients aged 18–79 years were recruited for a wide spectrum of frequent upper gastrointestinal symptoms (e.g., reflux and/or dyspeptic symptoms). A GERD cutoff score of 8 yielded a sensitivity of 65% and specificity of 71%.¹⁰ The study by Jonasson et al²⁵ enrolled primary-care adult patients referred for open-access endoscopy of suspected GERD. The optimal GerdQ cutoff score in their study was 9, corresponding to a sensitivity of 66% and specificity of 64% for the diagnosis of GERD. In their study, the enrolled patients represented a selected reflux population that had a higher prevalence of reflux esophagitis (81%) and a higher GerdQ cutoff score. In our study, patients aged 9–18 years were enrolled for warning upper gastrointestinal symptoms with a cutoff score of 7 for reflux esophagitis, yielding a sensitivity of 65.5% and specificity of 80%. The different cutoff scores may be due to different subjective feelings and presentations of symptoms in children compared to those in adults.

We found a higher prevalence of EE in school-aged children in this study (39.2%) than that reported in a previous study (10.5–19.6%).⁴ The higher incidence of EE in our study may be due to the presence of risk factors, including esophageal atresia, achalasia post balloon dilatation, hiatal hernia, intractable vomiting, hematemesis, and anemia, among the enrolled population.

Furthermore, of the six GerdQ items, four (heartburn, regurgitation, need for over-the-counter treatment, and sleep disturbance) are used to monitor and evaluate treatment response.¹⁰ A score of 2 or 3 in any of these items indicates treatment improvement. Results of the studies in adult patients showed that management of primary-care patients with GERD can be improved by systematic stratification of patients using GerdQ.^{11,21,25–28} Consequently, we believe that this questionnaire may be used as a tool for monitoring treatment response, which can improve management efficacy. Further studies are mandatory to validate the hypothesis. Recently, an algorithm of diagnosis and management of GERD was developed based on GerdQ.^{21,26} Therefore, GerdQ may be used, after validation, to develop a clinical pathway for pediatric GERD in the future.

In conclusion, Chinese GerdQ can be used in epidemiological studies to assess the frequency of occurrence of EE in 9–18-year-old children and may serve as a noninvasive post-treatment follow-up tool.

**Figure 2** ROC curve for GerdQ total scores.

Conflicts of interest

All authors declare no conflicts of interest.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.pedneo.2014.01.004>.

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